

PATENT COOPERATION TREATY

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From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

To:

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WRITTEN OPINION

(PCT Rule 66)

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04.03.2004

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International application No.
PCT/GB 03/00052

International filing date (day/month/year)
09.01.2003

Priority date (day/month/year)
11.01.2002

International Patent Classification (IPC) or both national classification and IPC
G01V1/36

Applicant

WESTERNGECO SEISMIC HOLDINGS LIMITED

1. This written opinion is the **first** drawn up by this International Preliminary Examining Authority.
2. This opinion contains indications relating to the following items:
 - I ☒ Basis of the opinion
 - II ☐ Priority
 - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - IV ☐ Lack of unity of invention
 - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - VI ☐ Certain documents cited
 - VII ☐ Certain defects in the international application
 - VIII ☐ Certain observations on the international application
3. The applicant is hereby **invited to reply** to this opinion.

When? See the time limit indicated above. The applicant may, before the expiration of that time limit, request this Authority to grant an extension, see Rule 66.2(d).

How? By submitting a written reply, accompanied, where appropriate, by amendments, according to Rule 66.3. For the form and the language of the amendments, see Rules 66.8 and 66.9.

Also: For an additional opportunity to submit amendments, see Rule 66.4.
For the examiner's obligation to consider amendments and/or arguments, see Rule 66.4 bis.
For an informal communication with the examiner, see Rule 66.6.

If no reply is filed, the international preliminary examination report will be established on the basis of this opinion.
4. The final date by which the international preliminary examination report must be established according to Rule 69.2 is: 11.05.2004

Name and mailing address of the international
preliminary examining authority:



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WRITTEN OPINION

International application No. PCT/GB 03/00052

I. Basis of the opinion

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this opinion as "originally filed"*):

Description, Pages

1-19 as originally filed

Claims, Numbers

1-20 as originally filed

Drawings, Sheets

1/8-8/8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This opinion has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

6. Additional observations, if necessary:

WRITTEN OPINIONInternational application No. **PCT/GB 03/00052****V. Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement****1. Statement**

Novelty (N)

Claims

Inventive step (IS)

Claims

1-6,10,11,13-15,17,19,20

Industrial applicability (IA)

Claims

2. Citations and explanations**see separate sheet**

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First invention :

claims 1-7, 10-15, 17,19,20

Re Item V**Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

1. It is reminded to the applicant that in the first invention, claims 1,10,13 (and corresponding apparatus claims 14,15) do not meet the requirements of Article 6 PCT for the following reasons :

-these claims have been drafted as separate independent method claims (and respective apparatus claims), they appear to relate effectively to the same subject-matter and to differ from each other only with regard to the definition of the subject-matter for which protection is sought. The aforementioned claims therefore lack conciseness. Moreover, lack of clarity of the claims as a whole arises, since the plurality of independent claims makes it difficult to determine the matter for which protection is sought, and places an undue burden on others seeking to establish the extent of the protection.

Hence, claims 1,10,13 (and corresponding apparatus claims 14,15) do not meet the requirements of Article 6 PCT.

In order to overcome this objection, it would be appropriate to file an amended set of claims defining the relevant subject-matter in terms of a single independent claim in each category followed by dependent claims covering features which are merely optional (Rule 6.4 PCT).

2. Reference is made to the following document

D1: SCHALKWIJK K.M ET AL.: 'Application of two-step decomposition to multicomponent ocean-bottom data : theory and case study' JOURNAL OF SEISMIC EXPLORATION, no. 8, 1999, pages 261-278, XP008017686 cited in the application

The document D2 was not cited in the international search report. A copy of the document is appended hereto. not enclosed

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D2: SHERIFF R.E. : 'Encyclopedic dictionary of Exploration Geophysics' page 45,
fig.C-15

3. The subject-matter of claim 1 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT for the following reasons.

Document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and teaches a method of processing multi-component seismic data obtained from seismic signals propagating in a medium (page 267). A window A is chosen that contains mainly primary reflections and a calibration filter $a(\omega)$ is determined from this window A of the seismic data. This calibration filter is used to calibrate a first component of the seismic data relative to a second component of the seismic data.

The subject matter of claim 1 of the present invention differs in that the selected portion of the seismic data contains only events arising from a critical refraction of seismic energy instead of primary reflections. However, this selection seems to be a straightforward possibility that the skilled person would select, in accordance with circumstances.

It is known for the skilled man that waves involving energy which enters a high-velocity medium (refractor) with an angle \geq the critical angle, travel in the high-velocity medium nearly parallel to the reflector surface and that the critical refraction event will consist only of upwardly propagating seismic energy above the seafloor.

This critical angle is related to the offset (critical distance) at which the reflection time equals the refraction time, and as this offset becomes \geq the crossover distance (see D2), the refracted event becomes the first break.

Thus, it does not involve an inventive step for the skilled man to select only events arising from critical refraction of seismic energy, since these events can be simply identified as first arrivals when offset \geq crossover distance.

In document D1, $a(\omega)$ is resolved with the condition that there should be no primary reflections present in the decomposed downgoing wavefield above the bottom and is calculated in such a way that in the decomposed downgoing wavefield, the energy in a window (containing only primary reflections) is minimized.

The skilled man would apply the same reasoning for a window containing only events arising from critical refraction of seismic energy. The imposed condition to resolve $a(\omega)$ would be that there should be no refractions present in the decomposed downgoing wavefield above the seafloor (data should contain only upgoing energy) and the

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calibration filter $a(\omega)$ could be determined by finding the calibration filter that minimizes the energy of the down-going pressure using a least squares process as described in D1.

Therefore, the subject matter of claim 1 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.

For the same reasons, the corresponding apparatus claim 14 does not involve an inventive step.

4. Dependent claims 2-6, 11, 17, 19 do not seem to contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of inventive step for the following reasons :

- claim 2 : a long-receiver offset allows the system to select as first arrival (see D2) events arising from critical refraction;
- claims 3,4 : see D1, pages 270-271;
- claim 5 : the minimization of the energy immediately above the seafloor of the downgoing constituent of the second component is disclosed in D1;
- claim 6 : the determination of a calibration filter from a portion of the seismic data containing only events arising from primary reflection is disclosed in D1;
- claim 11 : calibrating a first component of the seismic data using the calibration filter is disclosed in D1.
- claims 17, 19, 20 : technical features related to means for calibrating the first component of the seismic data using the first calibration filter, a programmable data processor and a storage medium are implicitly disclosed in D1.

5. Independent method claim 10 is related to the selection of a portion of the seismic data in which the first arrival contains only upwardly propagating seismic energy above the seafloor. The choice of long offset \geq crossover distance already allows the system to measure the refracted event as first break, (see paragraph 3), i.e. only the upwardly propagating seismic energy above the seafloor.

Therefore, the subject matter of claim 10 (and the corresponding apparatus claim 15) does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.

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6. Independent method claim 13 comprises the additional step of actuating a source of seismic energy and acquiring seismic data at a receiver spatially separated from the source. This step is disclosed in D1, therefore the subject matter of claim 10 does not involve an inventive step and does not satisfy the criterion set forth in Article 33(3) PCT.

Second invention :
claims 8,9,16,18

Reference is made to the following document:

D1: SCHALKWIJK K.M ET AL.: 'Application of two-step decomposition to multicomponent ocean-bottom data : theory and case study' JOURNAL OF SEISMIC EXPLORATION, no. 8, 1999, pages 261-278, XP008017686 cited in the application

The invention relates to a method (and the corresponding apparatus) of designing a calibration filter which depends on the wavenumber as well as on the frequency in order to calibrate a first component of the seismic data relative to a second component of the seismic data.

Document D1 is regarded as being the closest prior art to the subject-matter of claim 1 and teaches a method of processing multi-component seismic data obtained from seismic signals propagating in a medium (page 267). A window A is chosen that contains mainly primary reflections and a calibration filter $a(\omega)$ is determined from this window A of the seismic data. This calibration filter is used to calibrate a first component of the seismic data relative to a second component of the seismic data. The calibration filter proposed in this method is dependent only on frequency.

The subject-matter of independent method claim 8 and dependent claim 9 is therefore novel (Article 33(2) PCT).

It is known from document D1 to resolve the calibration filter $a(\omega)$ between the pressure and vertical velocity from primary reflection events for one offset (corresponding to the window containing primary reflections). The determination of a calibration filter for another offset containing only critical refraction events does not appear to involve an

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inventive step (see reasoning for the first invention).

However, the solution presented in claim 8 with the combination of several calibration filters for long and short offsets in order to design only one calibration filter which can be used for any offset has not been disclosed nor hinted in cited prior art documents and does not seem to be obvious for the skilled man.

Therefore, the subject-matter of independent method claim 8 and dependent claim 9 appears to involve an inventive step (Article 33(3) PCT).

For the same reasons, the corresponding apparatus claims 16, 18 are novel (Article 33(2) PCT) and inventive (Article 33(3) PCT).